COURSE DESCRIPTION CARD - SYLLABUS

Course name
Microwave Technology [S1MiKC2>TMikro]

Course

Field of study
Microelectronics and Digital Communication

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

A student entering this course should have knowledge of the basics of electronics, circuit theory, transmission lines, antenna technology, radio wave propagation, decibel calculus and electrical metrology. He or she should also be familiar with Smith's diagram, have the ability to calculate simple DC and AC electrical circuits, as well as the ability to obtain information from given sources and be ready to work together in a team.

Course objective

To learn about wave propagation in waveguides and the construction, principle of operation and parameters of microwave elements in waveguide and microstrip technology; to learn about the microwave propagation in the atmosphere and the description of the elements by means of the scattering matrix; to learn about the principle of operation of microwave tubes; to discuss semiconductor elements used in the microwave range; to present satellite systems and the basics of radar technology, to learn about measurement methods typical of microwave technology (scattering matrix, spectrum and network analyzer).

Course-related learning outcomes

Knowledge:

After completing the course, the student has detailed knowledge of electromagnetic wave propagation, construction, properties and measurements of antennas and antenna feeders implemented in waveguide and microstrip technology.

Skills:
Upon completion of the course, the student:
1. is able to analyze the phenomena of electromagnetic wave propagation in waveguides and design, implement and carry out measurements of antennas, antenna feeders and microwave elements (including preparation of test reports in accordance with PN-EN ISO/IEC 17025 standard)
2. knows how to evaluate the impact of the propagation environment on the transmission of radio signals and optimize the parameters of wireless systems
3. is able to acquire and analyze information from literature, databases and other sources in Polish and English
4. is able to effectively organize individual and team work and cooperate in a group, taking responsibility for the implementation of joint tasks (including planning the process of organizing measurements and make records of their results)
5. is able to apply the principles of occupational safety and health.

Social competences:
Upon completion of the course, the student:
1. knows the limitations of his own knowledge and skills, understands the need for further training
2. has a sense of responsibility for designed electronic and telecommunication systems and realizes the potential dangers to other people or society of their inappropriate use.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. knowledge acquired at lectures is verified during the final written and/or oral exam (duration of the written part 60-90 minutes; descriptive answer to 3-5 questions, the pass threshold of 50% points (grade 3.0) , the list of exam questions is sent by e-mail to students)
2. the knowledge and skills acquired in laboratory exercises are verified on the basis of the evaluation of the credit test (2-3 questions, duration 45-90 minutes, the pass threshold of 50% of the points - a grade of sufficient) and/or on the basis of the evaluations of the reports from laboratory exercises; the list of issues is sent by e-mail to students.

Programme content

Lecture
1. Location of microwaves in the em. spectrum and their characteristic features, propagation of microwaves in the Earth's atmosphere, the Doppler effect, propagation of em. waves in a waveguide, TE waves, TM waves, parameters of waveguides, strip and microstrip lines, components of microwave circuits made in waveguide and microstrip technology, impedance matching (5 h).
2. Voltages, currents and impedances in microwave circuits, reciprocal and lossless circuits, definition of scattering (S) matrix, calculation of S parameters for two port networks, vector network analyzer, measurement of S-parameters, construction and principle of operation of klystron, traveling wave tube and magnetron, microwave diodes and transistors (5 h).
3. Satellite TV, GPS system, Starlink, radar operating principle, radar equation, Doppler and pulse-doppler radar, radar cross section, stealth technology, electronic warfare (5 h).

Course topics

Laboratory
- preparatory part for practical exercises (solving calculus problems)
1. Wave propagation in free space
2. Impedance matching circuits (Smith's diagram).
3. Calculation of the scattering matrix parameters
4. Decibel calculus and estimation of measurement uncertainty
- practical exercises
1. Measurement of the scattering matrix parameters of filters and amplifiers
2. Measurement of selected microwave elements made in microstrip technique

3 Wave propagation in waveguides
4. Wave propagation in free space
5. The Doppler effect

Teaching methods

1. Traditional (informative) lecture: multimedia presentation supplemented by examples given on the blackboard, educational movies.
2. Laboratory exercises: solving measurement problems related to the experimental part, practical exercises performed in groups (2-4 people), based on written instructions, experimental demonstrations, educational movies.

Bibliography

Basic:
1. Szóstka J., Mikrofale. Układy i systemy, Wyd. Komunikacji i Łączności, Warszawa, 2006.
2. Szóstka J., Miernictwo radiokomunikacyjne, Wyd. Politechniki Poznańskiej, Poznań 2021.

Additional:
1. Szóstka J., Horyzontowe linie radiowe. Wyd. Politechniki Poznańskiej, Poznań 2011.
2. Szóstka J., Fale i anteny (wyd. III), Wyd. Komunikacji i Łączności, Warszawa 2006.
3. Pozar D.M., Microwave Engineering, John Wiley & Sons 2011.
4. Gustrau, F., RF and Microwave Engineering. Fundamentals of Wireless Communications, John Wiley & Sons 2012.

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	35	1,50